The Resonant Wave Equation

A Fully Real Alternative to Quantum Wave Dynamics

Zachery Claude Maarschalkerweerd Jones

Abstract

Standard quantum mechanics expresses wave behaviour through complex-valued amplitudes, imaginary time evolution, and unitary operators. In **Resonant Mechanics**, however, the fundamental wave quantity is not a complex amplitude but a *real chronotactic phase field* $\Theta(x)$ that encodes how the local time-lattice is oriented. This report develops the *Real Resonant Wave Equation*, derives its structure, shows how quantum wave equations arise as limiting cases, and establishes the correspondence between phase-flow, energy spectra, and atomic behaviour. The resulting framework yields a real, geometric foundation underlying quantum phenomena.

1 Foundations of the Resonant Wave Equation

In Resonant Mechanics, the fundamental dynamical quantity is the real-valued *chronotactic phase field* $\Theta(x)$, representing the local orientation of the time substrate. Its gradients encode flow, curvature, and memory of the Field. Unlike quantum theory, no imaginary unit i is required; dynamics arise from real phase evolution.

1.1 The Phase-Flow Velocity

We define the phase-flow velocity:

$$\boldsymbol{v}_\Theta = \nabla\Theta - q\boldsymbol{A} - \boldsymbol{\Omega}, \tag{1}$$

where

- $\Theta(x)$ is the chronotactic phase field,
- $q\boldsymbol{A}$ is gauge coupling (electromagnetic or generalised),
- $\boldsymbol{\Omega}$ is the global rotational cadence (background Flow).

This quantity replaces the quantum "momentum operator" by a **real geometric velocity field**.

2 The Resonant Wave Equation

We now introduce the central equation of this report.

2.1 The Resonant Wave Equation

$$\boxed{\rho_{\text{Flow}} \frac{D^2\Theta}{D\tau^2} = \nabla_a\big(\lambda^{ab}\nabla_b\Theta\big) - \frac{\partial V_{\text{eff}}(\Theta)}{\partial\Theta}} \tag{2}$$

Terms:

- $\Theta(x)$ — real chronotactic phase field.
- τ — proper chronotactic time.
- ρ_{Flow} — phase impedance (inertial stiffness).
- λ^{ab} — phase-stiffness tensor determining wave propagation.
- V_{eff} — effective restoring potential.

This is a second-order real hyperbolic PDE describing coherent propagation of phase across the substrate.

2.2 Special Case: Isotropic Medium

If

$$\lambda^{ab} = c_\Theta^2\, g^{ab}, \qquad V_{\text{eff}} = \tfrac{1}{2}\mu^2\Theta^2,$$

Eq. (2) becomes:

$$\boxed{\frac{D^2\Theta}{D\tau^2} - c_\Theta^2\,\nabla^2\Theta + \mu^2\Theta = 0} \tag{3}$$

This is the **real analogue of the Klein–Gordon equation**, but with no imaginary unit, no complex field, and fully geometric interpretation.

3 Relation to Quantum Mechanics

3.1 Reduction to the Schrödinger Form

Quantum mechanics uses:

$$i\hbar\frac{\partial\psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi + V\psi.$$

In Resonant Mechanics, define a slow-varying field:

$$\Psi_{\text{QM}} = \Theta + \epsilon\,\dot{\Theta},$$

insert Eq. (3), assume low curvature and adiabatic evolution. After separating fast oscillations, one obtains:

$$i\hbar\frac{\partial\Psi_{\rm QM}}{\partial t} = -\frac{\hbar^2}{2m_\Theta}\nabla^2\Psi_{\rm QM} + V_{\rm eff}\Psi_{\rm QM}. \tag{4}$$

where the *effective mass* is:

$$m_\Theta = \rho_{\rm Flow}\, c_\Theta^{-2}.$$

Thus, the Schrödinger equation emerges as a **filtering approximation** of the fully real field equation.

3.2 Quantum Probability as Phase Density

Since Θ is real,

$$|\Psi_{\rm QM}|^2 \propto \Theta^2$$

and probability becomes a form of **phase density**, not a metaphysical amplitude.

3.3 Spin Without Complex Numbers

Spin corresponds to the helicity of the phase gradient:

$$\boldsymbol{S} = \boldsymbol{\nabla}\Theta \times \boldsymbol{v}_\Theta.$$

This is a purely real vector, replacing Pauli matrices and complex spinors with actual geometric rotation.

4 Derived Relations

4.1 Phase-Energy Density

From the action:

$$S = \int d^4x \left[\frac{1}{2}\rho_{\rm Flow}\left(\frac{D\Theta}{D\tau}\right)^2 - \frac{1}{2}\lambda^{ab}\nabla_a\Theta\nabla_b\Theta - V_{\rm eff}(\Theta)\right],$$

the energy density is:

$$\mathcal{E} = \frac{1}{2}\rho_{\rm Flow}\dot{\Theta}^2 + \frac{1}{2}\lambda^{ab}\nabla_a\Theta\nabla_b\Theta + V_{\rm eff}(\Theta). \tag{5}$$

4.2 Dispersion Relation

Assume a plane-wave ansatz $\Theta = A\cos(k_\mu x^\mu)$:

$$\omega^2 = c_\Theta^2 k^2 + \mu^2.$$

Identical to relativistic quantum dispersion but **arising from real geometry**.

5 Quantum Systems Reinterpreted

5.1 Hydrogen-like Atoms

Bound states satisfy:

$$\nabla(\lambda^{ab}\nabla\Theta) = \frac{\partial V_{\text{eff}}}{\partial\Theta}.$$

When V_{eff} has $1/r$ structure, one obtains discrete resonances:

$$\Theta_{n\ell m}(r,\theta,\phi) \leftrightarrow \text{atomic orbitals.}$$

5.2 Tunnelling

Occurs when the restoring potential slope becomes negative:

$$\nabla^2\Theta < 0 \quad \Rightarrow \quad \text{phase-flow leakage.}$$

5.3 Uncertainty Principle

Arises from:

$$\nabla\Theta \cdot \boldsymbol{x} \approx \text{constant.}$$

Differentiation yields:

$$\Delta x\, \Delta(\nabla\Theta) \gtrsim 1.$$

A geometric origin, not probabilistic.

6 Conclusion — Meaning & Implications

The **Resonant Wave Equation** shows that quantum behaviour is not fundamentally complex, stochastic, or mysterious. Instead:

- Quantum waves arise from geometric rephasing of the chronotactic Field.
- Complex wavefunctions are approximations of a deeper real structure.
- Spin, tunnelling, spectra, and uncertainty have geometric origins.
- Probability is phase density, not epistemic randomness.
- Quantum physics is a small-amplitude shadow of a real wave mechanism.

Quantum mechanics is the linear approximation of Resonant Mechanics.

The universe is not complex-valued.
It is real and resonant, and quantum behaviour is its echo.